Probability distributions in modelling the financial data: A literature review

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Many researchers analyze quantitative financial data such as stock prices, income, currency exchange rates, interest rates and many other financial data in their studies with the main aim of modelling and forecasting. It is a difficult process to identify the true behavior of financial data due to its chaotic nature. However, it is a mandatory requirement to examine the nature of these data as they have a direct impact on the lives of individuals, organizations and countries' economic health conditions. A basic task in analyzing the financial data is to recognize a suitable statistical distribution of the data. For modelling financial data, one of the most common distributions applied in the literature is normal distribution. However, in the real world, most of these data are not normally distributed. Hence, the main purpose of this study is to demonstrate the selection of appropriate probability distributions for modelling financial data in a practical overview rather than relying on classic distributions. Overall, this literature review will convey a general idea to business practitioners and academic researchers in identifying suitable distributions in modelling the data. Several traditional financial models assume that the original data, returns or log-returns of the data follow normal, log-normal, exponential or beta distributions and the acceptance of this theory is widespread in practice. The main reason for this approach is the favorable properties of the distributions such as the existence of closed forms of probability density functions, easy and simple to estimate parameters for the data. Nevertheless, these distributions represent a limited number of distributional shapes and as a result, fail to identify the underlying characteristics of the data. Further, many studies evidenced that the financial data deviate from these classical distributions due to the skewness and heavy-tails (majority of the data in the tail) or fat-tails (more extreme values in the data) present in the data. There are flexible distributions such as the generalized lambda, normal inverse gaussian, Johnson translation system, the generalized beta family of distributions which were introduced to describe the diverse shapes of distributions. Another advantageous property of these distributions is that they can approximate some of the well-known distributions. Additionally, they can capture the uncertain movements of the financial data precisely. Other alternative distributions applied in the literature are stable, Tukey, power law, hyperbolic, skewed t and student t distributions and they are considered to have realistic and almost perfect fits for the data. Importantly, past studies provided more attention to the mixtures of normal distributions or compound normal distributions in fitting financial data as they have the ability to accommodate asymmetric and non-normal characteristics of empirical finance. Overall, there are several flexible distributions that can capture the true behavior of financial data. This study guides the researchers in selecting appropriate statistical distributions for the financial data rather than lying on classical standard distributions. Therefore, incorporating the accurate distribution in the financial models will provide more precise results and based on these results, government regulators, investors and businesses will be able to implement wise decisions.

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